

Remarks

35 U.S.C. § 102

In the Office Action, the Examiner has rejected Claims 15-16, 25-30, and 33-34 under 35 U.S.C. § 102 as being anticipated by United States Patent No. 5,534,328 issued to Ashmead et al. ("Ashmead") and Claims 16 and 33-34 under 35 U.S.C. § 102 as being anticipated by United States Patent No. 6,521,181 issued to Northrup ("Northrup"). Applicants respectfully traverse these rejections.

Ashmead does not disclose, among other features, a plurality of gas feed channels providing fluid communication between said continuous channel and said gas inlet port and a plurality of liquid feed channels providing fluid communication between said continuous channel and said liquid inlet port, wherein said plurality of gas feed channels is connected to said continuous channel by a microfluidic feed manifold, wherein said microfluidic feed manifold comprises an interleaved arrangement of said plurality gas feed channels and said plurality of said liquid feed channels. The interleaved arrangement of feed channels allows more intimate mixing of the reactants than the serpentine mixing chambers of Ashmead. For example, if a gas and a liquid were introduced into the reactor of Ashmead, the gas and liquid would segregate to form slugs or bubbles (at low gas flow rates) or an annular flow of liquid and gas (at high flow rates). In such cases, the mass transfer between the gas and liquid reactant mixture would be much less than the mixing achieved in a microfluidic feed manifold, wherein said microfluidic feed manifold comprises an interleaved arrangement of feed channels.

The subject application discloses a microfabricated reactor that is capable of enhancing the mass transfer of reactants with novel and non-obvious features. In the microfluidic channels in Ashmead, Northrup, and Bergh the interface

between the reactant streams would be determined primarily by the channel dimensions. The subject application comprises the manifold of interleaved channels resulting in the overall mass transfer rate being enhanced greatly, in some instances the overall mass transfer rate is increased at least one hundredfold greater than in the prior art devices. This is a significant effect that is not anticipated or obvious in the prior art; such art only discloses generally the mass transfer rates enhancements accompanied by the smaller size of microfabricated reactors without consideration of the complex nature of contacting reactants in a multiphase system as described in the subject application. For these reasons, Ashmead, Northrup, and Bergh do not, alone or in any combination, anticipate or render obvious amended Claim 15 or Claims 33-34 dependent from claim 15, or amended Claim 25 or Claims 26-30 dependent from Claim 25.

Claim 16 has been amended and is not anticipated by Northrup. Claim 16 describes a microfabricated chemical reactor comprising, among other things, at least one particle inlet formed in at least one lamina; and at least one particle inlet channel providing fluid communication between said at least one particle channel and said outlet port.

35 U.S.C. § 103

In the Office Action, Claims 31-32 are rejected under 35 U.S.C. § 103(a) as unpatentable over Northrup in view of Bergh and Ashmead in view fo Bergh. Applicants respectfully traverse these rejections.. According to § 2143 of the MPEP, “[t]o establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a

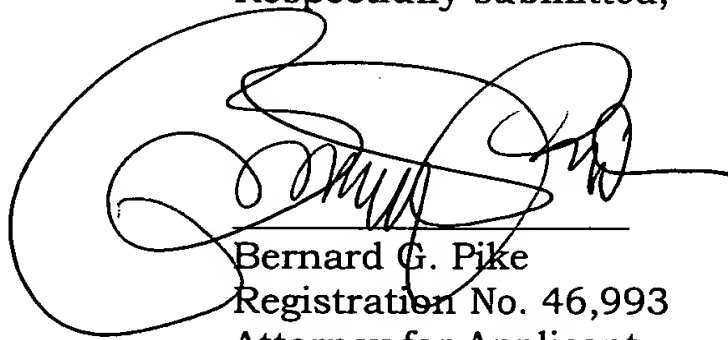
reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.” Applicants respectfully submit that the claims are non-obvious over the cited prior art for at least the reasons that the prior art does not suggest or motivate one to combine the teachings of cited prior art, and that the prior art references do not teach or suggest all of the claim limitations.

Applicants respectfully submit that a *prima facie* case of obviousness under 35 U.S.C. §103(a) requires, among other things, that the cited references, when combined, teach or suggest every element of the claim. *See e.g.*, MPEP § 2142. Ashmead, Northrup, or Bergh do not disclose a microfabricated chemical reactor adapted for conducting heterogeneous catalytic reactions with an overall mass transfer coefficient greater than 2 sec^{-1} . The overall mass transfer coefficient is not disclosed, nor is the importance of having an overall mass transfer coefficient in such a range disclosed. The Examiner points to column 23 of Bergh disclosing that the “substrate also preferably has an essential absence of passive microcomponents such as . . . mass-transfer agents (e.g. membranes).” The disclosure of the term “mass-transfer agents” does not disclose, suggest, or motivate the limitation that a a microfabricated chemical reactor adapted for conducting heterogeneous catalytic reactions with an overall mass transfer coefficient greater than 2 sec^{-1} . The inventors were the first to solve the problem of developing such a microreactor having these properties.

Conclusion

Applicants have made a diligent effort to fully respond to all the concerns and comments of the Examiner. Therefore, Applicants respectfully request that a timely Notice of Allowance be issued in the subject application. If the Examiner has any concerns regarding Applicants' present response, he is invited to contact Applicants' undersigned representative at the telephone number listed below so that those concerns may be expeditiously addressed.

Respectfully submitted,



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